Surface deformation monitoring provides unique data for observing and measuring the performance of producing hydrocarbon reservoirs, for Enhanced Oil Recovery (EOR) and for Carbon Dioxide Capture and Storage (CCS). To this aim, radar interferometry (InSAR) and, in particular, multi-interferogram Permanent Scatterer (PS) techniques are innovative, valuable and cost-effective tools.

Depending on reservoir characteristics and depth, oil or gas production can induce surface subsidence or, in the cases of EOR and CCS, ground heave, potentially triggering fault reactivation and in some cases threatening well integrity.

Mapping the surface effects of fault reactivation, due to either fluid extraction or injection, usually requires the availability of hundreds of measurement points per square km with millimeter-level precision, which is time consuming and expensive to obtain using traditional monitoring techniques, but can be readily obtained with InSAR data. Moreover, more advanced InSAR techniques developed in the last decade are capable of providing millimeter precision, comparable to optical leveling, and a high spatial density of displacement measurements, over long periods of time without need of installing equipment or otherwise accessing the study area.

Until recently, a limitation to the application of InSAR was the relatively long revisiting time (24 or 35 days) of the previous generation of C-band satellites (ERS1-2, Envisat, Radarsat). However, a new generation of X-band radar satellites (TerraSAR-X and the COSMO-SkyMed constellation), which have been operational since 2008, are providing significant improvements.

TerraSAR-X has a repeat cycle of 11 days while the two sensors of the COSMO-SkyMed constellation have an effective repeat cycle of just 8 days (the third sensor has already been successfully launched and is presently in the calibration phase). With the launch of the fourth satellite of the constellation, COSMO-SkyMed will have a revisiting time of just 4 days, allowing “near real-time” applications.

Additional advantages of the new X-band satellites are: a higher sensitivity to target displacement and a higher spatial resolution.
In this paper we present examples of X-band applications to reservoir monitoring with the aim of highlighting the technical features of the new sensors, the importance of continuous data acquisition and standardized acquisition policies for all InSAR applications.
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